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Improving Working Memory in Science Learning through Effective Multisensory Integration Approach

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ABSTRACT

Sensory integration takes place in the central nervous system where complex interactions such as co-ordination, attention, arousal levels, autonomic functioning, emotions, memory and higher level cognitive functions are carried out. Sensory integration gets information through the senses, puts it together with prior knowledge, information and memories already stored in the brain to make a meaningful response. Multi-sensory learning, as the name implies, is the process of learning a new subject matter through the use of two or more senses. This may include combining visual, auditory, tactile or kinaesthetic, olfactory and gustatory sensation. By activating brain regions associated with touch, flavour, audition and vision, they indicate a direct relationship between perceptual knowledge and sensory brain mechanisms. The investigator developed content based working memory test and pre assessment of the working memory of the students. Then researcher has developed multisensory integration model and taught though this model of science subject and find out post assessment of working memory in science. Finally investigator evaluated multisensory integration model on enhancing working memory in Science among the students.

Keywords: Improving, working memory, learning, science, multisensory integration approach.

INTRODUCTION

"Memory is the process of maintaining information over time." "Memory is the means by which we draw on our past experiences in order to use this information in the present' (Sternberg 1999). Memory is our ability to encode, store and retain subsequently recall information and past experiences in the human brain. It can be thought of in general terms as the use of past experience to affect or influence current behaviour. Memory is the sum totals of what we remember, and gives us the capability to learn and adapt from previous experiences as well as to build relationships. It is the ability to remember past experiences, and the power or process of recalling to mind previously learned facts, experiences, impressions, skills and habits. It is the store of things learned and retained from our activity or experience, as evidenced by modification of structure or behaviour, or by recall and recognition. In more physiological or neurological terms, memory at its simplest form is a set of encoded neural connections in the brain. Working memory (WM) is responsible for temporarily maintaining and manipulating information during cognitive activity (Baddeley 2002). It has been found to be closely related to a wide range of high-level cognitive abilities such as reasoning, problem-solving and learning. In addition, WM is related to academic achievement in the domain of reading, writing, mathematics and science (Gathercole & Alloway 2004).

Working memory also known as primary or short term memory registers and retains incoming, information "for a short time after its input." In other words, it is the memory that we use when we keep information consciously "in mind." Working memory makes possible a temporary impression of one's present environment in a readily accessible form.

Multi-sensory learning, as the name implies, is the process of learning a new subject matter through the use of two or more senses. This may include combining visual, auditory, tactile or kinaesthetic, olfactory and gustatory sensation (Scott 1993). By activating brain regions associated with touch, flavour, audition and vision, they indicate a direct relationship between perceptual

knowledge and sensory brain mechanisms. In Multisensory Integration approach, a child gets the opportunity to seen, auditory, touch, feel, taste, handle, and smell. Such sensory experiences are caused by external environmental stimulations.

OBJECTIVES OF THE STUDY

1. To design and develop Multisensory Integration Approach.
2. To implement the Multisensory Integration Approach on enhancing working memoryin science learning.
3. To find out the effect of the Multisensory Integration Approach on enhancing memory in science learningamong the students.

HYPOTHESES OF THE STUDY

The following are the Hypotheses for this study:

1. There is no significant mean difference between control and experimental group students in their working memory subtests in pretest.
2. There is no significant mean difference between control and experimental group students in their working memory subtests in posttest.
3. There is no significant mean difference between pretest and posttest Scores of working memory subtests in control group.
4. There is no significant mean difference between pretest and post test Scores of working memory subtests in experimental group.

METHOD OF THE STUDY

The present research has followed the two group pre-test post-test designs.

EXPERIMENTATION IN PHASES

Phase I

1. Understanding of the Multisensory Integration Approach.

2. Developing a systematic model for the application of multisensory integration approach instruction promoting working memory of science learning .
3. Identifying chapters related to the application of Multisensory Integration Approach in chemistry lessons in the science book of IX standard.

Phase II

4. Trying out the Effectiveness of Multisensory Integration Approach with a small group of students as pilot study.
5. Formation of two groups for conducting experiment, one is control group and another one is experimental group.

Phase III

6. Administering of working memory pre-test to the students.
7. Comparing the control and experimental group students based on pre-test working memory scores so as to enable them to establishing the equality of the two groups by mean and standard deviation.

Phase IV

8. The students of experimental group to be taught through Multisensory Integration Approach and control group to be taught through the traditional method of teaching.
9. Duration of the treatment would be of three months.

Phase V

10. Administering the working memory posttest after the completion of instructional units
11. Entering, categorizing and analyzing the pre-test and post-test scores

SAMPLE FOR THE STUDY

The present investigation was carried out in Government Boys Higher Secondary School, Thirukogarnam, Pudukkottai district. It is affiliated to the State Board of Higher Secondary Education, Government of Tamil Nadu. The Simple Random Sampling

Technique has followed in the study. In the school selected for the study, the IX standard students were taken for investigation, 60 were selected out of 90 students (other than 30 those selected for pilot study) in the IX standard formed the sample of the study.

Out of 3 groups in IX standard, A group assigned as control group, B group assigned as experimental group and C group already taken for pilot study. Students were randomly assigned to form the two groups – control and experimental group.

TOOLS AND DATA COLLECTION

Working memory test

The content based working memory test has used by investigator to assess working memory of the students. The content based memory test is modified form of the PGI Memory Scale. The PGI Memory Scale was constructed and standardized by Dwarka Pershad (1988). PGI Memory Scale was developed by Postgraduate Institute for Medical Education and Research (PGIMER) at Chandigarh in India. The investigator has modified PGI Memory scale to be suitable for chemistry content. It includes 10 subtests of which the investigator used the following 4 subtests only. The investigator established its reliability by split-half method and it was to be 0.74.

1. Memory Recall Test.
2. Memory Recognition Test.
3. Visual Retention Similar Pair Memory Test.
4. Visual imagery Memory Test.

1. *Memory recall test*

Participants are presented with stimuli and then after 10 minutes they are asked to remember as many of the stimuli as possible.

Investigator gives sample of the body of content. Students should carefully read it and memorize for specific period of time. After that they should write correct response to the appropriate stimuli.

2. *Memory recognition test*
Investigator gives the body of content. Students carefully read it and memorize for specific period of time. After that the investigator asked them to select the best possible answer out of the choices from a list.

3. *Visual retention similar pairs memory test*
The investigator gives a list of pairs. The students read it for specific period of time. After that the investigator gives a list of single terms; the students have to write the correct pair.

4. *Visual imagery test*
The investigator shows a card to the students. After a gap of 20 seconds the card is removed from the sight of the subjects. The investigator asks the students to draw what they have seen in the card. They draw in the paper from their memory the scene which they have seen.

The IX standard students were randomly assigned to form two groups, control and experimental group. Experimental group students were taught through Multisensory Integration Approach. Control group students were taught through traditional method. Initially they were administered the working memory test to find out the memory level in subject. The reliability of the memory tests was established. They were found to be significant.

SCHEME OF DATA ANALYSIS

In the present investigation the scores secured by the students of two groups in the pre-test & post-test were tabulated. The mean and standard deviation were calculated and described. To find out the difference between the two groups in estimating the extent of relative effectiveness among the two groups, “t” test was employed.

Table 1. *Differential analysis of working memory sub tests in the pre-test of control and experimental groups*

S. No	Memory sub tests	Tests	Groups	Mean	SD	't' Value	Remarks
1	Memory Recall	Pretest	Control	41.70	15.05	0.02	NS*
			Experimental	42.75	17.12		
2	Memory Recognition	Pretest	Control	42.65	16.7	0.39	NS*
			Experimental	43.43	17.1		
3	Visual retention Similar Pair	Pretest	Control	40.70	15.46	0.01	NS*
			Experimental	42.93	19.62		
4	Visual Imagery	Pretest	Control	41.00	14.56	0.80	NS*
			Experimental	44.37	20.1		

NS*=Not significant 0.05 level

The above table shows the "t" value for Working Memory sub tests in the pre-test of the control and experimental groups.

As seen from table the calculated "t" value 0.02 is lower than table value at 0.05 level. Hence there is no significant mean difference between the Memory Recall Test scores of control and experimental group in the pre-test. The calculated "t" value is 0.39 which is lower than the table value. Hence there is no significant mean difference between Memory Recognition Test scores of Control and experimental groups in the pretest.

The calculated "t" value is 0.01 which is lower than the table value. Hence there is no significant mean difference between Visual Retention Similar Pair Memory Test scores of control and experimental groups in the pretest.

The calculated "t" value is 0.80 which is lower than the table value at 0.05 level. Hence there is no significant mean difference between Visual Imagery Memory Test scores of control and experimental groups in the pretest.

Table 2. *Differential analysis of working memory sub tests in post-test of the control and the experimental groups*

S. No	Memory Sub Tests	Tests	Groups	Mean	SD	't' Value	Remarks
1	Memory Recall	Posttest	Control	43.83	10.98	6.00	S*
			Experimental	61.67	8.20		
2	Memory Recognition	Posttest	Control	51.87	10.66	8.07	S*
			Experimental	60.93	6.92		
3	Visual retention Similar Pair	Posttest	Control	42.87	10.65	9.91	S*
			Experimental	62.60	6.19		
4	Visual Imagery	Posttest	Control	43.70	13.65	6.54	S*
			Experimental	61.63	6.77		

S*=Significant 0.05 Level

As seen from the above table the calculated "t" value is 6.00 which is greater than the table value at 0.05 level. Hence there is significant mean difference between the Memory Recall Test scores of control and experimental groups in the posttest.

The calculated "t" value is 8.07 which is greater than the table value. Hence there is significant mean difference between the Memory Recognition Test scores of control and experimental group in posttest.

As seen from the above table the calculated "t" value is 9.91 which is greater than the table value at 0.05 level. Hence there is significant mean difference between the Visual Retention Similar Pair Memory Test scores of control and experimental groups in the posttest.

As seen from the table the calculated "t" value is 6.54 which is greater than the table value. Hence there is significant mean difference between the Visual Imagery Memory Test scores of control and experimental groups in the posttest.

FINDINGS

The following are the findings of the study:

1. It is found that there is no significant mean difference between control and experimental group of Working Memory subtests Test in Pretest.
2. It is found that the Working Memory subtests Test scores of experimental group is greater than the control group in posttest.
3. It is found that the Working Memory subtests scores of posttest of experimental group is greater than the pretest of experimental group.

CONCLUSION

The present research has suggested Multisensory Integration Approach plays a vital role in improving working memory in science. Further it is observed that the Multisensory Integration Approach expands the learning schema, since the learners is able

to activate appropriate sensory integration. This contributes to constructivist learning situation. This facilitates the teacher's task of enabling the students to apply Multisensory Integration Model in enhancing working memory. Hence educational planners, administrators and curriculum designers should play a vital role in restructuring teacher education courses at all levels with the incorporation of Multisensory Integration Approach components (steps). This research study highlights the need for optimum utilization of the Multisensory Integration Approach to gain maximum educational benefits to the society.

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